Appendix B, Chapter 12
Cutthroat Trout

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12.0 Cutthroat Trout (Oncorhynchus clarki clarki)

The life history of the coastal cutthroat subspecies *(Oncorhynchus clarki clarki)* is probably the most complex and flexible of any Pacific salmonid (Northcote 1997). Cutthroat trout are generalists—they exhibit several life histories and exist in many small streams not suitable for other salmonids. Cutthroat trout are widely distributed in Washington lower Columbia River tributary systems and are not federally listed. Because most individuals are resident or fluvial, cutthroat trout are more affected by local habitat conditions than by mainstem Columbia River and estuary effects.

The subspecies, sea-run cutthroat trout in the Southwest Washington/Northwest Oregon area, was a candidate for listing as threatened, but the USFWS found that a listing was not warranted. Cutthroat have been documented in over 1,300 locations within the lower Columbia distinct population segment. Because coastal cutthroat trout are not a listed species, historical populations and recovery criteria have not been identified by the Willamette/Lower Columbia Technical Recovery Team.

12.1 Life History and Requirements

The flexibility of coastal cutthroat subspecies allows the expression of many life history patterns (Figure 12-1). They can rear to maturity in salt or fresh water, migrate large distances, remain in their natal area throughout their life, or exhibit any combination of these behaviors. The following terms define the potential life histories expressed by coastal cutthroat:

- anadromous—fish that migrate to sea during their life,
- fluvial—fish that migrate but remain within a stream until maturity,
- adfluvial—fish that migrate to rear in a reservoir or lake to maturity, or
- resident—fish that rear to maturity near their natal area.

Their diverse life history strategies have enabled the coastal cutthroat subspecies to persist where other salmonid species have not. Isolated above migration barriers in most coastal streams, coastal cutthroat trout are the only salmonid species present, and in small streams, they often are the only species of fish (Connolly 1997, Heggenes et al. 1991b, Glova 1987).

Multiple life history forms frequently coexist in the same watershed and even in the same stream (June 1981, Johnston 1982, Heggenes et al. 1991a, Johnson et al. 1999). Where multiple forms coexist, it is possible for temporal and spatial differences in reproductive behavior to promote genetic differentiation (Zimmerman 1995). It is also possible for some subbasins within a drainage to contain entirely anadromous or entirely freshwater forms (Zimmerman 1995, Johnson et al. 1999). Observed migration patterns suggest that life history patterns may vary within as well as among subpopulations.

There is evidence to suggest that life history patterns may be flexible. For example, research has shown that some sea-run cutthroat may spawn before their first saltwater migration (Giger 1972, Tomasson 1978, Fuss 1982, Johnson et al. 1999). It is evident that not all individuals within a population behave similarly, even if they exhibit the same given life history pattern. Individuals in a cohort may respond to environmental factors differently at any point along the migratory pathway. This suggests that individuals may possess some degree of adaptive flexibility (Dill 1983, Johnson et al. 1999).

Northcote (1997) reviewed the diversity of life-history strategies of coastal cutthroat trout, often in the same basin, and concluded that:

> *"[T]he coastal cutthroat trout has responded to pressures of environmental variability and unpredictability by partitioning its populations into a broad migratory/residency spectrum, 'bet-hedging' its long-term continuity . . ."*

This 'bet-hedging' represents a strength of the species that has enabled it to persist in a large number of streams throughout its range where other salmonids are absent, or where migration has been blocked.

The observed complexity of life history forms of coastal cutthroat trout and the intermingling of various forms within populations, along with the plasticity of individuals within any given life history pattern, make identification of discrete life history types challenging for any single individual or population.

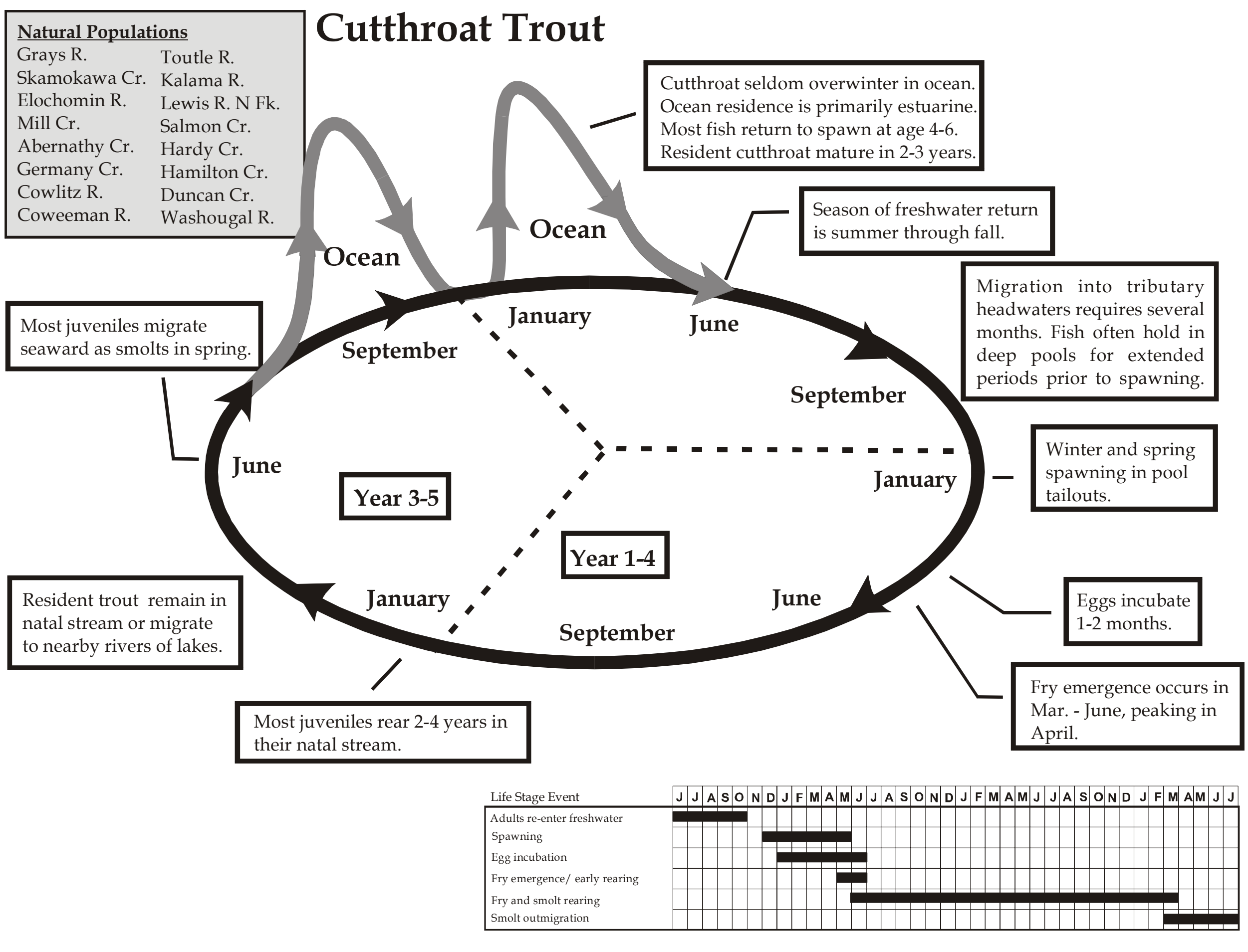

Figure 12-1. Cutthroat trout life history.

12.1.1 Upstream Migration Timing

If coastal cutthroat trout exhibit any of the migratory life histories, migration timing to spawning areas is quite variable among populations. Sea-run cutthroat trout may return to spawn from late June through the following April. Re-entry timing is relatively consistent across years within a stream, but varies widely between streams (Giger 1972).

Peak upstream migration of sea-run cutthroat in Oregon coastal rivers is typically in the fall (mid-September through October (Giger 1972)), and they do not overwinter in the ocean. Pearcy (1997) reported that the highest number of sea-run cutthroat appeared in ocean purse seine catches from May to early August. The fall run timing of sea-run fish is confirmed by the peak in late summer in sport catch in Oregon estuaries of sea-run cutthroat. Giger (1972; p.12) concluded from the timing of sport catches in the Siuslaw, Alsea, and Nestucca rivers, "*dates of occurrence of peak catches on the study streams were quite similar, indicating that groups of fish were entering all streams at approximately the same time*." Further, Giger (1972; p.12) who seined only in the Alsea, noted that peak catches by seine and by the sport fishery showed "*reasonably good agreement*." Trotter (1989) reviewed coastal cutthroat life histories along the entire coast of North America, and found that upstream migration in large streams typically begins in July or August and peaks in September to October.

The timing of departure from the estuary on the upstream journey appeared to be related to stream temperatures. Giger (1972) reported that in both 1969 and 1970, the movement of sea-runs out of the Alsea estuary coincided with September's first sharp drop in stream temperatures. Based on observations in three study streams (Siuslaw, Alsea, and Nestucca), Giger (1972; p.19) concluded, "*It was believed to be high temperature that primarily restricted use of the upper estuary sections during July and August*." Thus, sea-run cutthroat appeared to remain in the estuary into the fall until after stream temperatures dropped. Giger (1972) reported that the cutthroat fishery was shortest in the Nestucca estuary and lasted longest into the fall in the Siuslaw estuary. Stream temperatures entering those estuaries were lowest and highest respectively for the three estuaries he studied.

12.1.2 Spawning

Coastal cutthroat trout typically spawn from December through June, with peak spawning in February (Trotter 1989). Redds are made mainly in small streams (less than 10 cfs base flow) with low gradients, typically in pool tailouts with water depth of 6-18 in (15-45 cm) (Trotter 1997). Redds are constructed in substrate where particle size ranges from 0.2-2 in (5-50 mm) in diameter (Trotter 1997, Cramer 1940). Coastal cutthroat pairs engage in spawning activity during both day and night, and the ritual can extend up to 3 days (Trotter 1997, Scott and Crossman 1973).

Cutthroat spawn in small headwater streams, generally upstream of all other anadromous salmonids, although some overlap may occur (Johnston 1982). Edie (1975) surveyed tributary and mainstem areas throughout the basin of Washington's Clearwater River in both 1973 and 1974, and found that chinook predominated in the lowermost stream reaches, coho predominated in the intermediate stream reaches, and coastal cutthroat were the most abundant species in the headwaters where gradient is high (2-6%) and channels are small (1-10 feet [0.3-3 m]). Similarly, Johnston (1982) reported that cutthroat spawn in small headwater stream areas upstream from the more dominant salmonids, and that these streams usually average less than 5 cfs during summer. Montgomery et al. (1999) classified channels in Pacific Northwest streams into three categories of gradient: <1%, 1-3%, and >3%; in most streams, stream gradients >3% correlated with the cutthroat-only zone (no chinook, coho or steelhead).

Behnke (1992) noted, "*Where coastal cutthroat and rainbow trout coexist, they are ecologically separated at spawning by the preference of cutthroat trout for smaller tributary streams and of rainbow trout for main river channels*." Moring and Youker (1979) reviewed available data on cutthroat trout in the Willamette basin, and found that most spawning takes place in small streams with flows as low as 0.5-1.0 cfs. DeWitt (1954) surveyed cutthroat trout in streams of the northern California coast, and found, "*Fish-of-the-year were taken only in the very smallest tributaries, usually in those with summer flows less than one cubic foot per second. Most of the cutthroat brood streams examined were too small to be named*."

Magee et al. (1996), investigating west slope cutthroat trout spawning, found in a large Montana river basin that, although suitable spawning gravels were located throughout the basin, most redds were clustered in two areas within first and second order tributaries. Spawning streams were only 3-10 ft wide (1-3 m) with low to moderate gradients (0.5-3.8%). Sumner (1962) found from comprehensive sampling of a small watershed on the Oregon coast that cutthroat spawned in the smallest tributaries available.

Recent studies of west slope cutthroat trout in Montana have indicated that, even though egg survival was greatly depressed by sedimentation, rearing habitat rather than egg survival was the limiting factor to population size. Magee et al. (1996) examined the distribution and particle composition of cutthroat trout redds in the Taylor Fork of the Gallatin River, a sediment-rich basin. Substrate embeddedness in the areas where cutthroat built redds was high, averaging 50%. The cutthroat trout in this study were resident, and average spawner FL was only 7.4 in (189 mm) for males and 7.5 in (191 mm) for females. In spite of the high fine-sediment levels in the redds, and the low survival of eggs expected with so much fines, sedimentation did not appear to limit recruitment. Magee et al. (1996) reached the following conclusion, "*Our results support the theory that resident salmonid populations are typically not limited by reduced spawning success and that recruitment is probably limited by available rearing habitat*."

Coastal cutthroat trout are iteroparous, with high incidences of repeat spawning (Trotter 1997). While some fish spawn each year for at least 5 years, not all fish spawn every year. Some may not return to salt water but rather remain in fresh water for a year or more (Giger 1972, Tomasson 1978). Research documenting significantly larger sizes for spawning females than males—along with anecdotal evidence of large females spawning with smaller, cryptically colored males—suggests that males may be able to exhibit precocious maturation (Johnson et al. 1999).

12.1.3 Incubation and Emergence

Incubation period expressed in degree-days ranges from 362-500—usually 6–7 weeks (Trotter 1997, Johnson et al. 1999). A literature review by Bell (1986) reported optimum temperature for egg incubation from 39.9-54.9°F (4.4-12.7°C).

After hatching, developing embryos require 100-350 degree-days before emergence from the gravel (Trotter 1997, Johnson et al. 1999). Emergence occurs between March and June depending on location and time of spawning (Trotter 1997); peak emergence takes place in April (Giger 1972, Scott and Crossman 1973, Johnson et al. 1999). Total length of newly hatched fry is about 1.0 in (25 mm) (Trotter 1997). Fry move to stream margins and backwaters quickly after emergence, where they remain throughout summer (Glova and Mason 1976, Moore and Gregory 1988, Johnson et al. 1999).

Cutthroat fry typically emerge later and at smaller size that other salmonids (Johnston 1982, Griffith 1988). Thus, spatial separations during spawning may be an important evolutionary adaptation to reduce competition for suitable sites and to reduce interaction of young-of-year (YOY) cutthroat with behaviorally-dominant salmonids (Johnson et al. 1999). The adaptation to spawning in small streams also may provide refuge for age 0 cutthroat from competition or predation by older fish of the same species, because several studies have shown that older year classes of cutthroat out-compete younger ones for rearing space. Bisson et al. (1988) found a sharp difference in habitat preference of age 0 cutthroat from that of older age groups that appeared to result from competition. Age 0 cutthroat preferred backwater pools and glides, but avoided pools in the main channel, while age 1 and older cutthroat strongly preferred pools in the main channel. Connolly (1996) found that densities of age 0 cutthroat in pools of 16 coastal streams was negatively correlated to abundance of age 2 and older fish (age 0 abundance increased as age 2 decreased). Connolly (1997) argued that competition for space between age classes—not spawning success—regulated the abundance of cutthroat in coastal streams.

12.1.4 Juvenile Rearing

Juvenile rearing of cutthroat trout usually progresses downstream as age increases, except with resident forms that may move only a few meters during their life. Cutthroat fry typically rear for their first year in the small headwater streams where adults spawn, higher in the basin than other salmonids except for bull trout (Sumner 1962, Lowry 1965, Sumner 1972, Edie 1975, Magee et al. 1996).

House (1995) showed large annual fluctuations in cutthroat abundance in a stream of the Molalla River basin that retained stable habitat and no major perturbation events over 11 years, particularly among YOY trout. Abundance of age 2 cutthroat fluctuated 6-fold, while ages 3 and 4 fish fluctuated only 2-fold between years. House (1995) concluded, "*Models that obtain data by separating habitat types and that consider only older age-classes of trout may be the most accurate in predicting changes in population levels*." This finding is consistent with the deduction that space for rearing of age >2 cutthroat was the limiting factor to cutthroat production, because regardless of high or low abundance of age 0-2 fish, abundance of age >2 fish changed relatively less.

Connolly (1996) used a different study format to arrive at conclusions similar to those of House (1995). Connolly (1996) sampled resident cutthroat in 16 coastal streams above barriers, and found habitat units (e.g. pool or riffle) with adult cutthroat present usually had only one or two adults. Further, "*pools with adult cutthroat trout often lacked young-of-year cutthroat trout, and pools without adults often had numerous young-of-year*." Connolly (1996) repeated sampling between years in two streams, and found that abundance of age 2+ cutthroat dropped following the 1992 drought, but abundance of age 0+ fish increased. Connolly (1996) concluded that pool vacancy created a strong opportunity of YOY. Thus, competition between age classes affected their abundance in different habitat types. Similarly, Reeves et al. (1997) report that cutthroat populations were reset to predominantly age 0 in Needle Branch Creek following summers of drought with near zero flow in 1988 and 1992.

As further evidence that pool habitat is a limiting factor to cutthroat production, habitat restoration projects that create new pools have been found to increase production of age 1+ and older cutthroat. Solazzi et al. (1997) created about 10 new pools per km in two test streams on the Oregon coast; he found that production of cutthroat smolts increased 2- to 4-fold relative to control streams. House (1996) examined the effects that placement of instream habitat structures in the East Fork of Lobster Creek, Oregon, had on salmonid production. These treatments significantly increased surface area of pool and low-gradient riffle habitats, and "*treated areas supported significantly more juvenile coho salmon and cutthroat trout and had higher overall salmonid biomass than control areas, whereas age-0 trout (cutthroat trout plus steelhead) and juvenile steelhead showed no increases*."

Other research indicates that habitat for age 0 fish and for overwintering of age 1 and older fish are generally not limiting factors. Solazzi et al. (1997) sampled cutthroat during summer and winter in numerous coastal streams of Oregon, and found no strong preference during winter for any habitat type. This finding suggests there is not a specific habitat in short supply during winter. Chapman and Knudsen (1980) found in paired test and control stream sections that biomass of cutthroat trout per surface area of stream was reduced in test sections (channelized or grazed) for age 1 and older fish, but not for age 0 fish. Thus, the limitation came at age 1 and older rather than age 0. However, Tschaplinski (2000) found in Carnation Creek that scarcity of cobbles large enough to provide winter refuge for yearling steelhead caused steelhead to seek cover in rootwads and pools. These are not the typical winter cover for age 1+ steelhead. Given that steelhead and cutthroat are a minor part of the fish fauna in Carnation Creek, Tschaplinski (2000) reasoned that lack of cobble substrate was a limiting factor responsible for the low steelhead abundance in Carnation Creek. Because cutthroat and steelhead show similar winter habitat preferences, we assume that cutthroat likewise would be limited if cobbles were scarce.

12.1.5 Juvenile Migration

Age 1+ parr of migratory types emigrate from their natal stream to rear downstream, primarily in pools (Sumner 1962, Lowry 1965, Sumner 1972, Giger 1972, Edie 1975, Fuss 1982, Bisson et al. 1988, Trotter 1989, Dambacher 1991, Magee et al. 1996). In the fall, some of these fish will find overwinter habitat where they are, and others will migrate back upstream toward their natal area (Sumner 1962, Lowry 1965, Sumner 1972, Giger 1972). The migrating juveniles are referred to as parr, rather than smolts, because they do not undergo the physiological change that prepares them for adaptation to living in salt water. The second spring, age 2+ juveniles again migrate downstream to larger water, some traveling as far as the estuary (Sumner 1962, Lowry 1965, Sumner 1972, Giger 1972, Trotter 1989). These migration patterns by parr are similar for fluvial, adfluvial, and anadromous life histories of cutthroat trout.

Many studies have found a progressive downstream movement of cutthroat each year as they increase in age and size. Sumner (1962) sampled cutthroat trout extensively in the Sand Creek basin on the northern Oregon coast and found,

> *"The downstream movement of initial migrants was by stages. Fingerlings marked in a small tributary of Sand Creek above the traps apparently left their natal stream at the age of 1 year in the usual downstream-migration period and spend a year in the main stream above the rack, some of them passing down through the trap the following spring."*

Similarly, Lowry (1965) studied cutthroat movements in three streams in the Alsea River basin and found that age 1 fish moved downstream from their natal stream throughout the spring and summer to rear in large channels downstream. Trotter (1989), in his compendium of cutthroat life histories reported,

> *"Juvenile cutthroat trout that survive their first winter range more widely than young-of-the-year fish (Giger 1972). Sometimes as early as the winter of their first year, but more generally in the spring, many begin downstream movement to the main stem.*

The onset of winter freshets triggers an upstream movement that often takes the fish back into the tributaries."

Downstream movement of age 1+ and older cutthroat during spring, followed by upstream movement during fall, is typical of both the fluvial and sea-run life histories. Giger (1972) fished a full weir on Crooked Creek, a major tributary of the Alsea River (at RM 54 [86.9 km]), and found that both parr and smolt cutthroat outmigrated in spring. Outmigration past the trap peaked in April, followed by outmigration of smolts from the estuary in mid-May, as determined by seining. Giger (1972) reported, "*Essentially all ocean-destined migrants had left the estuary by the end of May.*" Also of note, the last fish to migrate downstream in the spring were the parr, and they were more numerous than smolts throughout April and May. The consistency of this behavior between years indicates that the stimulus to migrate downstream in spring is an inherited trait that affects both parr and smolts. In 1968, 500 of these parr were tagged at the Crooked Creek trap, with many tagged fish captured by anglers in the Alsea River and estuary through the summer. Giger (1972) found that "*One-year-olds were notably absent from the samples taken at Crooked Creek or in the estuary*." Age 1 parr did not move downstream, and nearly all of the migrant parr were age 2 fish greater than 4.3 in (110 mm) long. (Crooked Creek is a large tributary, and cutthroat spawning areas likely would be far upstream from the trap in tributaries or headwater areas.)

Migratory and nonmigratory cutthroat do rear together in the same reaches of a stream, and they can be distinguished only by whether or not they migrate. In one coastal stream where both resident and anadromous cutthroat were studied together, Heggenes et al. (1991a) found that resident cutthroat selected considerably deeper habitats than actively migrating cutthroat. Heggenes et al. (1991a) found that 48% of resident cutthroat moved less than 10 ft (3 m) from their home site in this stream during the 9 months studied (winter to late summer). While most of the population was static, a small fraction was mobile and was recovered at the farthest sampling station over 984 ft (300 m) from their starting point. Observed timing of presence in fresh water indicated "*a substantial proportion of the mobile fraction of the population consisted of residents*" and that others were likely anadromous. Heggenes et al. (1991a) concluded, "*We were unable to tell which fish were anadromous, although the larger fish are likely to be*." These observations underscore that different life-history types of coastal cutthroat do rear in the same streams and are difficult to distinguish.

Smoltification in cutthroat trout and other salmonids involves various morphological, physiological, and behavioral changes. Visual evidence of smoltification includes loss of parr marks and the development of a silvery appearance. Earliest and latest recorded ages of smoltification in sea-run coastal cutthroat are 1 and 6, respectively (Trotter 1997).

Studies of sea-run cutthroat consistently show that size and age at smolting is related to growth rate, which is influenced by habitat suitability, light, nutrients, and temperature. Most sea-run juveniles smolt between ages 2+ through 4+, with faster-growing fish tending to smolt at a younger age (Sumner 1962, Bulkley 1966, Giger 1972, Sumner 1972, Fuss 1982). This consistent finding across many studies indicates that slower-growing individuals must survive more years before smolting (Sumner 1962, Lowry 1965, Sumner 1972, Giger 1972, Fuss 1982, Frissell 1992, Harvey and Nakamoto 1997). This also indicates that slower growth would lead to older age at maturity, which is likely true of either migratory or non-migratory cutthroat trout. Generally, cutthroat that reached 6 in (145 mm) by their second annulus smolted in the spring of that year (Sumner 1972, Giger 1972, Trotter 1997). Fish that reached that size at their first annulus, were generally about 50% longer at age 2 than fish smolting at age 3+ and 4+. Thus, a 50% increase in growth rate would likely reduce average age at smolting by 1 year.

Several lines of evidence indicate that survival is greater for faster-growing individuals. First, faster growth clearly results in younger age at maturity, and since survival is a function of time, those fish maturing in less time face lower mortality. Second, Fuss (1982) noted that back-calculated size-at-age of surviving adult cutthroat (based on scales) typically showed that adult survivors were larger than average at each age compared to juveniles sampled in the stream. Finally, experiments of hatchery sea-run cutthroat trout demonstrate that survival to adulthood is positively correlated to size-at-release. Tipping (1986) differentially tagged cutthroat in 0.4 in (1 cm) length intervals from 6-10 in (16-25 cm) for release in 1982 and again over the range of 7-9 in (18-23 cm) in 1983. Combined returns of these fish to the hatchery and sport fishery showed an exponential increase in survival as smolt length increased up to 8.7 in (22 cm) in 1982 and up to 9 in (23 cm) in 1983. There was no increase in survival as smolt length increased from 8.7-9.8 in (22-25 cm) during 1982, but cutthroat in a natural setting likely would smolt before reaching such lengths.

Giger (1972) noted that parr were recruited into the estuary during spring "*following which individuals became remarkably sedentary,*" during summer. Giger (1972) deduced, "*The spring downstream shifting or progression of non-smolting juvenile cutthroat is a logical feature for this species which spends from two to five years in fresh water before migrating to sea.*" Parr captured in the estuary were about 55% age 2 and 40% age 3. Mean length of parr was 6 in (146 mm) while the mean length of smolts was 9 in (231 mm). Because many cutthroat are migratory, the densities of juvenile cutthroat in any given stream section during summer do not reflect production of fish born in that area. Headwater streams will be depopulated during summer following spring emigration of parr, while the larger channels will be populated by fish migrating from upstream.

12.1.6 Adults in Freshwater

Several studies have shown that densities of age >2 cutthroat consistently differ between channel unit types, and that stratification of cutthroat densities by channel unit type is a useful starting point for classifying habitat capacity. Cramer (1998) found from snorkeling 90 reaches of small-channel streams distributed throughout the Umpqua basin that age 2 and older cutthroat (> 8 in [> 203 mm]) were predominantly in pools, occasionally in riffles, and rarely in glides. Sleeper (1994) found about 85% of cutthroat were in pools during six snorkel surveys in Cummins Creek, Oregon, where flow ranged from 3.5-475 cfs during the 18 months studied. Sleeper (1994) concluded, "*For the most part, salmonid abundance was directly related to pool size.*"

The dependence of cutthroat production in small streams on pools was further confirmed by an analysis of cutthroat presence or absence in streams above barrier falls in the Umpqua basin. Cramer (1998) found a linear correlation between the percentage of 110 streams above barrier falls that had cutthroat present, and the number of pools available upstream of the barrier. Every stream with more than 52 pools present above the barrier (there were 22 of these) still had fish present, even though these small stream segments had been isolated most likely for thousands of years. With reference to length of stream, every stream with more than 3 miles (5 km) of stream habitat above the barrier (there were 10 of these) had fish present (Cramer 1998). The difference in these measures of habitat availability resulted from differences in gradient and geomorphology between streams (Cramer 1998). The percentage of surface area composed by pools was negatively correlated to stream gradient, and presence of cutthroat above barrier falls also was negatively correlated to stream gradient. All 10 streams with gradients of 2% or less had fish present, and none of the nine streams with 18% gradient or more had fish present. Cramer (1998) found this same gradient limit (about 18%) was operative as well for cutthroat presence in streams without migration barriers.

ODFW extensively sampled rearing densities of anadromous salmonids in various habitat types of Oregon coastal streams during 1985-92, with the intention of developing a habitat capacity model for steelhead and cutthroat (Johnson et al. 1991, 1993). They used multiple pass electrofishing and mark-recapture techniques to estimate fish densities. In order to reduce bias from lack of seeding (spawner densities in each stream were unknown) they excluded streams from their calculation if average fish densities were less than 0.1 parr/m^2 in main-channel pools. From their samples in 30 qualifying streams, densities of cutthroat > 3.5 in (90 mm) long in the main-channel averaged about 0.19 fish/yd^2 (0.16 fish/m^2) in pools, 0.012 fish/yd^2 (0.01 fish/m^2) in riffles, 0.024 fish/yd^2 (0.02 fish/m^2) in rapids, and 0.05 fish/yd^2 (0.04 fish/m^2) in glides (Johnson et al. 1993).

Cramer (1998) found that the proportion of pools with cutthroat > 8 in (20 cm) present increased as maximum pool depth increased. To express this quantitatively, Cramer grouped fish observations for pools in half-foot increments in depth for each subbasin (North, South, and Main Umpqua) and calculated the percentage of pools in that increment with cutthroat > 8 in (20 cm) present. In all three subbasins, Cramer (1998) found no cutthroat > 8 in (20 cm) in pools < 1 foot deep (0.3 m) and the highest frequency of cutthroat in pools > 3 feet deep (0.9 m). Cramer (1998) indicated that the use of pools by cutthroat increases by a factor of about 2.5 for each foot of increased depth.

Similar findings have been reported by Bisson et al. (1988) for third and fourth order streams in western Washington and by Heggenes et al. (1991b) for a coastal stream in British Columbia. Bisson et al. (1988) found that both age 1+ and 2+ cutthroat trout were most abundant in deep pools. Bisson et al. (1988) showed a positive correlation of cutthroat use with pool depth and a similar relationship for age 1+ steelhead. The relationship with age >1 cutthroat showed that the depth preference crossed from negative to positive as depths exceeded about 9.8 in (25 cm). Conversely, age 0+ cutthroat tended to use shallow pools and showed a negative correlation of pool use to pool depth. Further, Bisson et al. (1988) found, "*Average depth did not strongly affect habitat use by underyearlings of any species, but age-1+ steelhead and age-1+ and age-2+ cutthroat trout preferentially used deep pools with ample cover*." Edie (1975) also found that habitat preferences changed sharply between age 0 and age 1 for juvenile steelhead and cutthroat. "*The younger trout make heavy use of the riffle areas of the stream and the older fish utilize the pools*." Edie (1975) distinguished cutthroat and steelhead at age 1 and found the preference for pools was greater among cutthroat than among steelhead, and that most of this difference came from less use of riffles by cutthroat.

Cramer (1998) found that the percentage of riffles with cutthroat > 8 in (20 cm) present was also related to water depth; deeper riffles had a higher probability of cutthroat being present. In the lower Umpqua subbasin, only two of 235 riffles (0.9%) under 0.75 feet deep (0.2 m) had an adult cutthroat present, whereas eight of 50 riffles (16.3%) that were 1 foot (0.3 m) or more deep had adult cutthroat present. In the North Umpqua, where there was more variation in riffle depth, no cutthroat were found in the 80 riffles < 1 foot deep, two (4%) were found in the 70 riffles 1-2 feet deep, and two (20%) were found in 10 riffles that were greater than 2 feet deep. In the South Umpqua, only two of 129 riffles surveyed had cutthroat present and both of those riffles were 1 foot deep. As in the other subbasins, about half of all riffles in the South Umpqua were less than 1 foot deep. Studies in other streams have also shown that cutthroat use of riffles is dependent on depth. Sleeper (1994) conducted snorkel surveys in Cummins Creek, and found that riffles were too shallow for use during summer, but received heavy use where they were sufficiently deep.

Cramer (1998) found that characteristics of each pool and riffle, other than depth, showed no correlation to cutthroat presence. Stream temperature did not help explain variation in the numbers of fish present in streams of the Umpqua basin, and Cramer (1998) observed cutthroat in streams where temperature was recorded at 80°F (27° C) (Calapooyia Creek), although fish were in deep pools that may have been thermally stratified.

Research has shown that inherent differences between watersheds with surface rocks predominantly of basalt (relatively hard) and of sandstone (relatively soft) result in general differences in use of those watersheds by cutthroat trout. Reeves et al. (1997) found that watershed disturbance in basalt watersheds had less deleterious effect on cutthroat trout than in sandstone watersheds. Reeves et al. (1997) cite several studies showing little effect of logging in basalt basins of the Cascade range, but substantial reductions in cutthroat production following logging in sandstone streams of the coast range. They suggest that temperature and sedimentation rates were less in the basalt watersheds so fish could benefit from increased light penetration after shading was reduced. They also point out that basalt streams have more boulders than sandstone streams (i.e. basalt is harder to break down, so particles are larger and slower to transport).

Hicks (1989) found in sandstone streams that substrate was commonly bedrock, while in basalt streams, bedrock was only typical as a lateral boundary of channel units. Basalt is harder than sandstone and likely to result in a greater depth to width ratio than sandstone, thus riffles and glides for a given flow would likely be deeper and narrower in a basalt stream than a sandstone stream. Since cutthroat show a strong preference for greater depth, the combination of more boulders and greater depth may explain the stronger tendency of cutthroat to disperse out of pools in basalt than sandstone streams. Hicks (1989) concluded from his comparison of basalt and sandstone streams:

> *"Streams in basalt had relatively high channel gradients (mean 2.6%) with channel morphology more conducive to production of steelhead, resident rainbow trout, and cutthroat trout than to production of coho salmon. Such streams had large substrate inherently provided considerable habitat stability and complexity."*

12.1.7 Estuary and Ocean

Sea-run coastal cutthroat stay close inshore while in salt water, typically within 30 miles (50 km) of the shore (Trotter 1997). Residence time in salt water is typically short. Studies in Oregon and Alaska indicate that coastal cutthroat trout remained at sea an average of only 91 days, with a range of 5–158 days (Giger 1972, Jones 1973, 1974, 1975, Johnson et al. 1999). In these studies, ocean migration patterns appeared similar from year to year, with individuals remaining close to shorelines and rarely crossing open bodies of water wider than 5 miles (8 km).

In some populations, ocean residence periods are spent primarily or entirely in estuarine and tidewater environments (Northcote 1997, Trotter 1997). On the Oregon coast (Giger 1972, Sumner 1972, Tomasson 1978) and in the Cowlitz River (Tipping 1981), adult cutthroat will remain in the estuary throughout the summer, returning to fresh water in the fall. Tomasson (1978) reported that coastal cutthroat trout in the Rogue River system did not enter the open sea, but remained in the estuary throughout the summer. He posited that sea-run coastal cutthroat trout in the Rogue River may remain in the estuary to avoid predation by half-pounder steelhead that reside in the nearshore ocean in the summer. Even in populations that venture into the nearshore ocean, reports indicate that sea-run cutthroat prefer ocean environments of relatively low salinity and high freshwater influences, such as the nearshore plumes of large rivers (Trotter 1997). The highest incidences of sea-run cutthroat catches in the ocean off the Washington and Oregon coasts have been in areas where temperature averages 56° F (13.4 °C) (Pearcy 1997, Trotter 1997).

Marine survival of sea-run cutthroat trout can be higher than that of other salmonids by as much as 40%, with predation the main cause of mortality in the ocean environment (Giger 1972, Trotter 1997).

12.2 Distribution

The coastal cutthroat trout is the most widely distributed and abundant of all cutthroat subspecies. It is native to the coastal belt from Prince William Sound in southeastern Alaska to the Eel River in northern California. In Washington, *O. c. clarki* exists in both sea-run and resident forms, and is found inland to the Cascade Crest (Trotter 1989). Their geographic distribution coincides with the coastal temperate forest belt (Johnson et al. 1999). The subspecies seems to be highly adapted to this region, and even where there is access beyond the coastal forests, they do not penetrate far inland (Sumner 1972, Trotter 1989, Johnson et al. 1999). Anadromous, fluvial, and resident life history forms distribute themselves throughout lower Columbia tributary watersheds (Figure 12-2). Resident forms have been observed throughout the subbasins from the Grays River to Bonneville Dam (WDFW 2000). Anadromous forms exist in all Washington tributaries of the lower Columbia and access to spawning habitat is available in most watersheds. However, upstream migrants are excluded from upper tributary reaches in each subbasin, where steep gradients and high flows can limit passage (WDFW 2000).

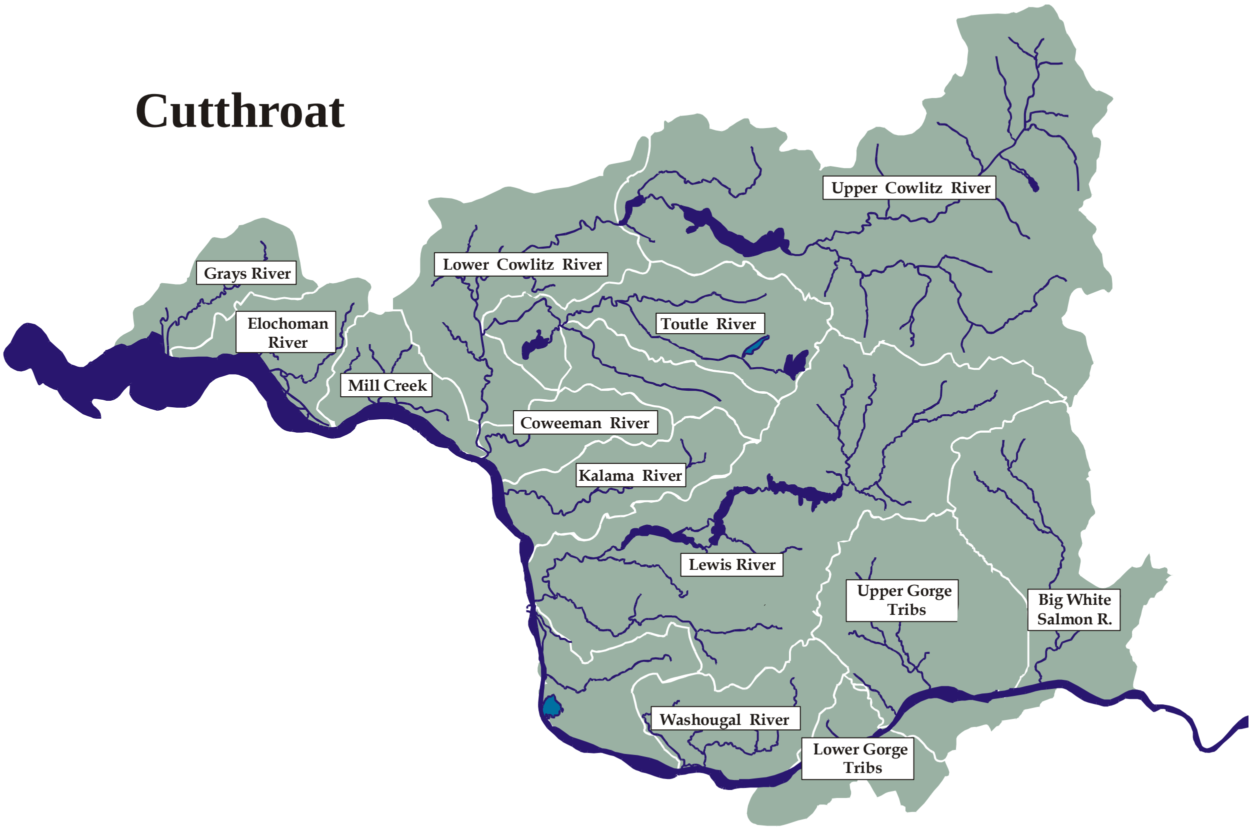

Figure 12-2. Distribution of historical cutthroat trout populations among lower Columbia River subbasins.

12.3 Genetic Diversity

Behnke (1992) posits that cutthroat trout are native to western North America and, along with rainbow trout, broke off from a common trout ancestral form in the Snake and Columbia River basins approximately 2 million years ago. About 1 million years ago, the coastal cutthroat subspecies diverged and has remained intact, colonizing rivers from northern California to Alaska (Behnke 1997, Johnson et al. 1999).

Coastal cutthroat trout differ from other anadromous Pacific salmonids in that they exhibit a greater level of genetic diversity among local populations (Johnson et al. 1999). This may be a result of greater reproductive isolation between groups, higher levels of genetic drift in smaller populations, or a combination of the two. Though different populations of coastal cutthroat trout may consist primarily of one life history type or another, genetic research suggests that different life history forms do not represent different evolutionary lineages (Johnson et al. 1999).

Hybridization between coastal cutthroat trout and rainbow/steelhead is widespread (Johnson et al. 1999). About one-third of coastal cutthroat trout samples collected by researchers in British Columbia, Washington, Oregon, and California contained hybrids (Johnson et al. 1999). Cutthroat-rainbow hybrids tend to have intermediate morphological and behavioral characteristics, and may have lower fitness as a result (Johnson et al. 1999). Most hybrids detected with molecular methods are 0+ and 1+ fish, and adult hybrids are not often observed. Still, the presence of introgressed individuals in some populations suggests that at least some hybrids can mature and reproduce successfully.

12.4 ESU Definition

The Southwestern WA/Columbia River coastal cutthroat ESU includes naturally spawning populations (and their progeny) below natural barriers in the Columbia River and its tributaries downstream from Klickitat River (WA) and Fifteenmile Creek (OR), inclusive, including Willamette River downstream from Willamette Falls, and in coastal drainages between Columbia River and Grays Harbor (WA), inclusive.

12.5 Life History Diversity

The life history of the coastal cutthroat is probably the most complex and flexible of any Pacific salmonid. Cutthroat trout are generalists—they exhibit several life histories and exist in many small streams not suitable for other salmonids. Isolated above migration barriers in most coastal streams, coastal cutthroat trout are the only salmonid species present, and in small streams, they often are the only species of fish (Connolly 1997, Heggenes et al. 1991b, Glova 1987).

Multiple life history forms frequently coexist in the same watershed and even in the same stream (June 1981, Johnston 1982, Heggenes et al. 1991a, Johnson et al. 1999). Where multiple forms coexist, it is possible for temporal and spatial differences in reproductive behavior to promote genetic differentiation (Zimmerman 1995). It is also possible for some subbasins within a drainage to contain entirely anadromous or entirely freshwater forms (Zimmerman 1995, Johnson et al. 1999).

There is evidence to suggest that life history patterns may be flexible. It is evident that not all individuals within a population behave similarly, even if they exhibit the same given life history pattern. Individuals in a cohort may respond to environmental factors differently at any point along the migratory pathway. This suggests that individuals may possess some degree of adaptive flexibility (Dill 1983, Johnson et al. 1999).

The observed complexity of life history forms of coastal cutthroat trout and the intermingling of various forms within populations, along with the plasticity of individuals within any given life history pattern, make identification of discrete life history types challenging for any single individual or population.

12.6 Abundance

The total abundance of coastal cutthroat trout in the lower Columbia basin is difficult to estimate because of their wide range of life history types, the lack of commercial harvest, and low hatchery production figures. Coastal cutthroat are reported in all lower Columbia River drainages, and anadromous individuals are either documented or believed to be present in all Washington tributaries feeding the Columbia downstream of Bonneville Dam.

Because only distribution and not abundance data exist for resident cutthroat trout in lower Columbia tributaries, the status of this life history form cannot be determined (WDFW 2000). At present, WDFW describes cutthroat as depressed in all rivers entering the Columbia from its mouth to the Kalama River, citing either long-term negative trends or short-term severe declines (WDFW 2000). The abundance of coastal cutthroat trout in the Lewis River and in tributaries entering the Columbia between the Lewis River and Bonneville Dam is unknown, because of lack of data.

Data used to document sport harvest of coastal cutthroat was collected during a 1971–95 salmon and steelhead study where data on cutthroat also was recorded. No distinctions between life history forms were made, but most cutthroat caught were presumably anadromous or fluvial. Sampling protocols exhibit some inconsistencies, especially in the earlier years, and some sampling was incomplete. Changes in angling regulations during the study may have affected cutthroat catch, but the extent of any reduction cannot be determined. Therefore, the quality of coastal cutthroat sport catch data in the lower Columbia is only fair. Total sport harvest from 1971–95 shows a sharp decline in sport catch after 1985, when more restrictive angling regulations were implemented (Figure 12-3).

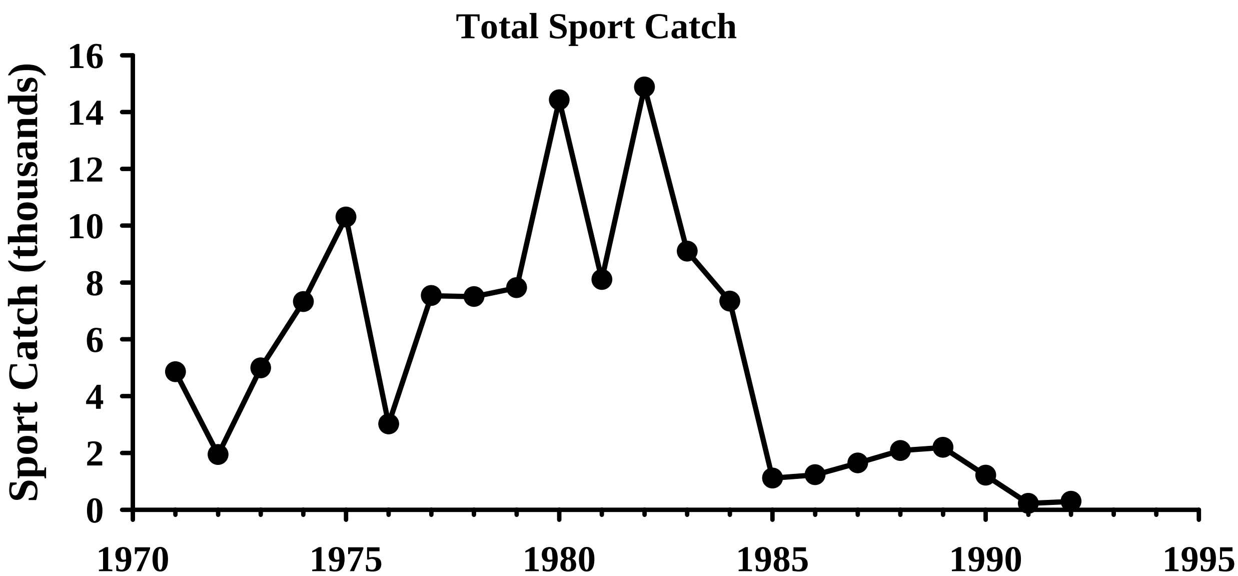

Figure 12-3. Total sport catch of coastal cutthroat trout in lower Columbia Washington tributaries. Data used to generate this figure are incidental to data collected during salmon and steelhead studies. No data for the Lewis River or tributaries from the mouth of the Lewis to Bonneville Dam is available.

Escapement measured at a weir trap in the Elochoman River evidences a decline after 1976, though the data are missing from 1981–87. Cowlitz River trap counts fluctuate around a mean of about 2,000 fish, and do not exhibit a downward trend over the 24 years from 1971–94, with a high of 6,103 fish in 1982 and a low of 383 fish in 1988 (Figure 12-4).

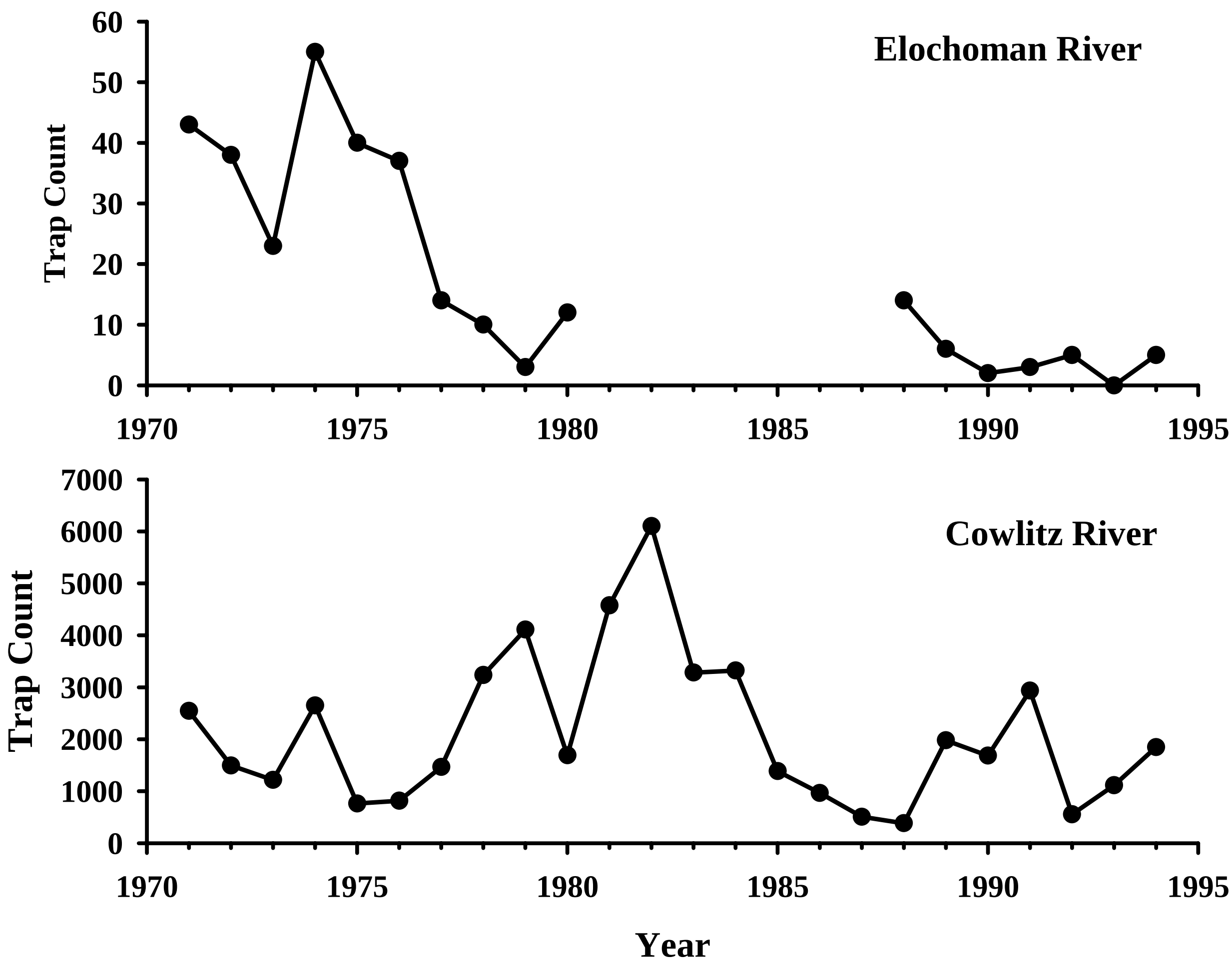

Figure 12-4. Coastal cutthroat counts at Elochoman River and Cowlitz River weir traps, 1971–94.

12.7 Productivity

A NMFS status report on sea-run cutthroat trout in the lower Columbia River indicates that returns of both naturally spawned and hatchery-produced fish have declined in almost all lower river tributaries over the past 10–15 years. The potential reduction in life-history diversity is a key concern. In many streams, freshwater forms are well distributed with relatively high abundance in comparison to anadromous forms in the same streams. NMFS concluded that habitat degradation and poor ocean and estuarine conditions are the likely causes of the severe depletion of anadromous forms of cutthroat trout.

12.8 Sea Run Cutthroat Fishery

There is no direct commercial harvest of coastal cutthroat trout, and gill-net mesh size is too large for much incidental handle of cutthroat in the fishery. Angler harvest of coastal cutthroat trout has declined significantly since the implementation of more restrictive sport regulations in 1985 aimed at protecting wild anadromous salmonids (Figure 12-5). Tributaries in all subbasins in the lower Columbia region are closed to retention of wild (unmarked) cutthroat. Open fishing periods differ from subbasin to subbasin but many have spring closures to protect spawning cutthroat and steelhead. Sport catch of cutthroat trout is open year-round in some reservoirs. Hooking mortality does occur, particularly during steelhead/salmon seasons, but the extent of wild cutthroat mortality from hooking and illegal harvest is believed to be low (WDFW 2000).

In 1985, the daily bag limit on the Columbia River was reduced from 8 to 2 trout with a 12 in (30 cm) minimum size (subsequently raised to 14 in [36 cm]). The change was aimed at allowing most female cutthroat to spawn at least once before harvest. In 1992, wild cutthroat release regulations were implemented basin-wide.

Columbia River anadromous coastal cutthroat are not harvested in Pacific Ocean or Columbia River commercial fisheries, and incidental impacts from these fisheries is negligible. Directed harvest only occurs in sport fisheries, which selectively harvest hatchery sea-run cutthroat produced from the Cowlitz Trout Hatchery. The sport fishery harvest of hatchery cutthroat occurs primarily in mainstem Columbia and Cowlitz River bank fisheries. Hatchery cutthroat programs at Beaver Creek in the Elochoman River, Merwin Hatchery in the Lewis River, and Skamania Hatchery in the Washougal River were terminated in recent years due to budget shortfalls and poor return rates of the hatchery produced cutthroat trout.

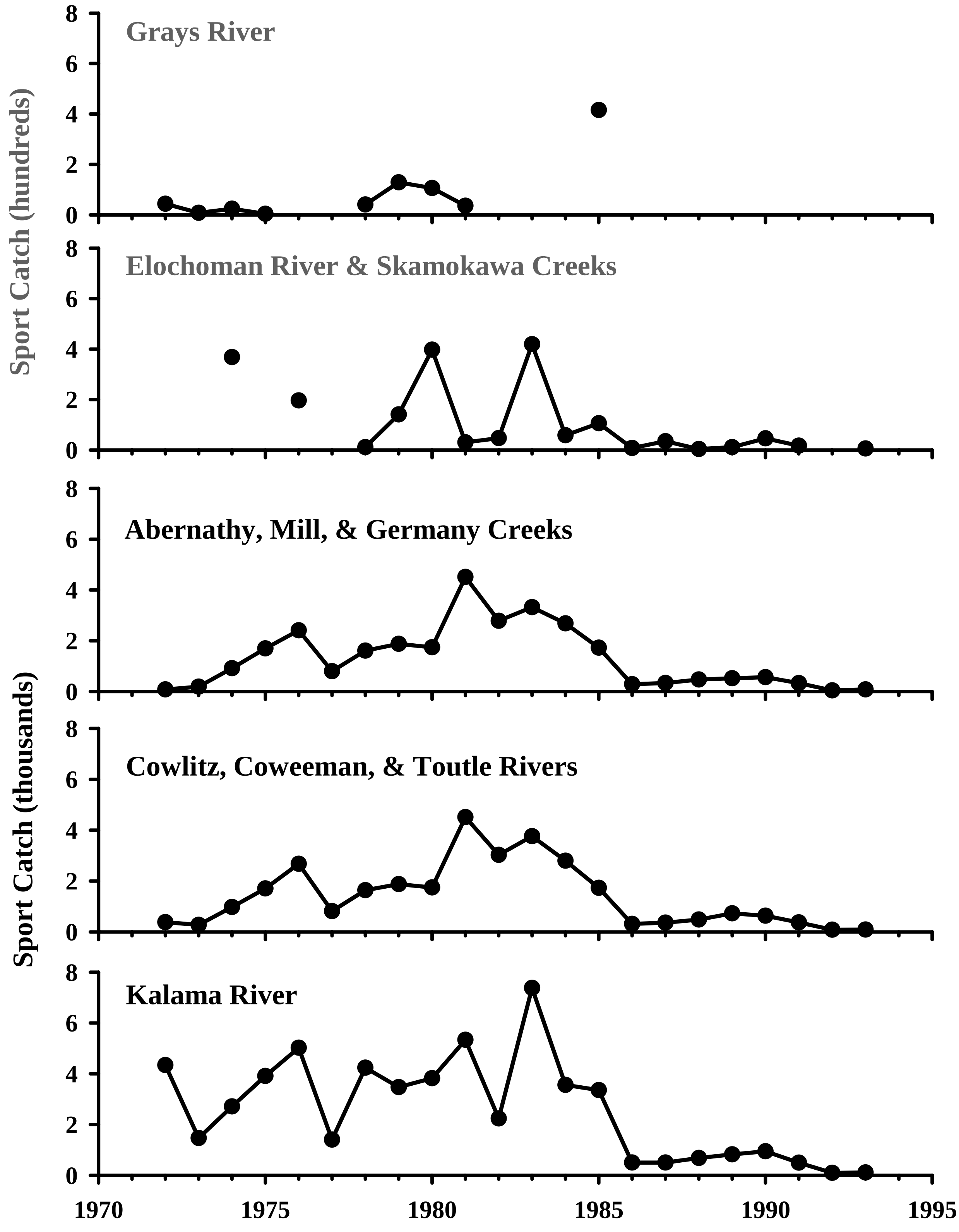

Figure 12-5. Sport angler harvest of coastal cutthroat trout.

12.8.1 Cutthroat Trout Harvest Over Time

Harvest of cutthroat trout in lower Columbia Washington tributaries averaged about 7,000 per year until 1985 when more restrictive regulations were enacted to protect wild trout and juvenile salmonids. After 1985, tributary harvest was reduced to only a few hundred per year (Figure 12-6).

Columbia River mainstem sport catch of cutthroat in the 1970s was significant, with estimated harvest typically in the range of 4-10,000 per year. Harvest steadily decreased in the 1980s, and the annual catch dropped to a low of 500 fish in 1987 (Figure 12-7). Wild cutthroat release regulations were enacted in the Columbia River in 1994.

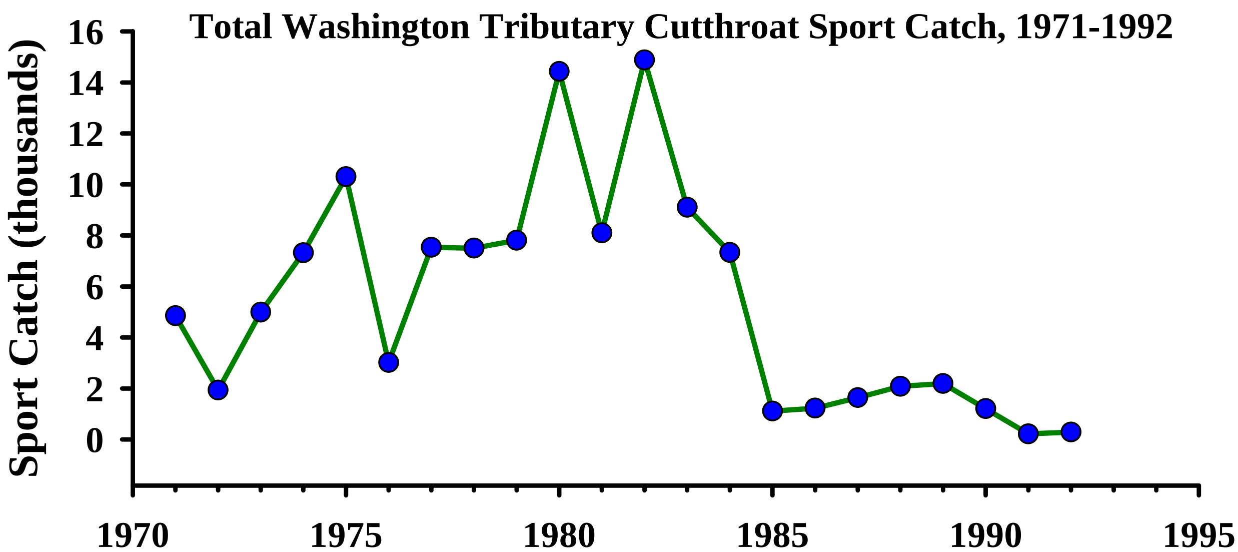

Figure 12-6. Total sport catch of coastal cutthroat trout in lower Columbia Washington tributaries. Data used to generate this figure are incidental to data collected during salmon and steelhead studies. No data for the Lewis River or tributaries from the mouth of the Lewis to Bonneville Dam is available.

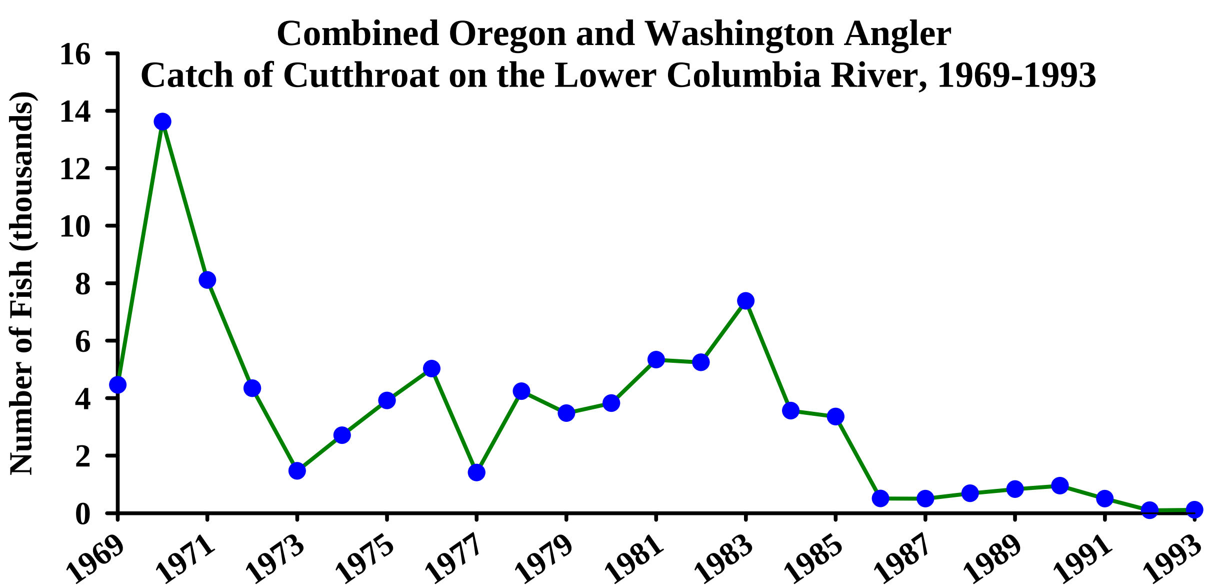

Figure 12-7. Catch of cutthroat trout on the Lower Columbia River, 1969–93.

12.8.2 Current Cutthroat Trout Harvest

Hatchery cutthroat trout continue to be harvested in the mainstem Columbia River and Washington (Cowlitz) tributary sport fisheries. Wild release and minimum size regulations have reduced impacts to wild cutthroat trout significantly. The Columbia River harvest of cutthroat has averaged less than 100 fish annually since wild cutthroat release regulations were implemented in 1994 (Figure 12-8).

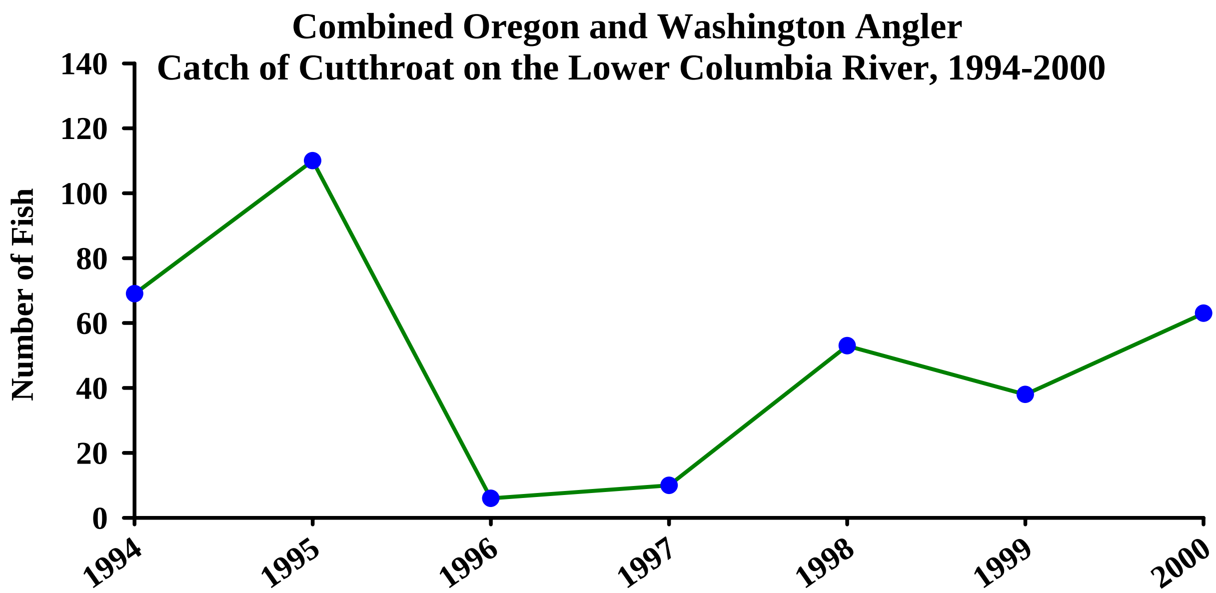

Figure 12-8. Catch of cutthroat trout on the lower Columbia River, 1994—2000.

12.8.3 Cutthroat Trout Harvest Management Details

Washington biologists introduced a fishery management strategy to meet conservation needs of resident and anadromous trout populations in 1985. Minimum size and bag limits were made different for lakes and streams to provide maximum angler access to trout planted from hatcheries into standing waters and in reservoirs above dams, and increase protection of wild trout and juvenile salmonids in streams.

Trout fisheries have the potential to impact juvenile salmonids and anadromous cutthroat. However, WDFW has implemented time and area, bag limit, and size restrictions to reduce impacts. The general trout season is June 1–October 31, which maintains a closed season during the peak smolt out-migration period in the spring. The minimum legal size in small streams is generally 8 inches (20 mm) to protect smolts and 12-14 inches (30-35 mm) in larger streams to protect anadromous cutthroat trout and larger steelhead smolts. The bag limit is two legal-sized trout. An important management objective for sea-run cutthroat is to allow most to spawn at least once prior to being subjected to harvest. Most first-year spawning cutthroat are less than 12 inches (30 mm), and virtually all first-year spawners are less than 14 inches (35 mm).

During 1992-94, wild cutthroat release regulations were enacted in all Washington tributaries where anadromous cutthroat are present, and in the mainstem Columbia River. The minimum size of 12-14 inches (30-35 mm) is still important for wild sea run cutthroat protection even though all wild fish must be released. The minimum size rule assures that smaller cutthroat are still protected from retention by anglers that have not accurately identified the species.

Selective gear rules are imposed in some areas, usually upper watershed streams, to promote catch and release fisheries where fish populations are depressed. These restrictions allow only the use of unscented artificial flies or lures with one single barbless hook, and prohibit the use of bait. Most areas where anadromous cutthroat are present allow bait to be used. Hooking mortality is presumed to be higher with use of bait and was estimated at 6-8% for sea-run cutthroat caught with worm-baited hooks in the Samish River. Trout hooked with bait and released must be counted towards the daily bag limit in Washington.

As an illustration of rules to protect sea run cutthroat, Table 12-1 represents the trout regulations in most Washington streams in the lower Columbia. This table represents only open seasons, minimum size, bag limit, and special rules for 2003-04. It does not represent all of the specific regulatory requirements for fishing in these streams, including specific open and closed areas. Complete fishing regulation information is contained in the Washington Sport Fishing Rules Pamphlet, 2003/2004.

Table 12-1. Trout fishing regulations in lower Columbia tributaries in Washington.

Stream	Season	Min. Size	Bag Limit	Special Rules
Deep River	Year-round	14”	2	Release wild cutthroat
West Fork Grays	June 1–Aug. 31	8”	2	None
East Fork Grays	June 1–Oct. 31	14”	2	Release wild cutthroat Selective gear rules
Elochoman River	June 1–Mar. 15	14”	2	Release wild cutthroat
Mill Creek Abernathy Creek Germany Creek	June 1–Aug. 31 Nov. 1–Mar. 15	14”	2	Release wild cutthroat
Coal Creek	June 1–Aug 31 Nov.1–Feb 29	14”	2	Release wild cutthroat
Coweeman River	June 1–Mar. 15	12”	2	Release wild cutthroat
Lower Cowlitz	June 1–Mar. 31	12”	5 (2 > 20”)	Release wild cutthroat
Upper Cowlitz (Clear Fork & Muddy Fork)	June 1–Oct. 31	8”	2	Release cutthroat
Tilton River	June 1–Mar. 31	8”	5 (1 > 12”)	None
EF, NF, SF, WF Tilton River	June 1–Oct. 31	12”	2	Selective gear rules
Cispus River	June 1–Oct. 31	8”	2	Release cutthroat
NF Cispus River	June 1–Oct. 31	8”	2 (1 > 12”)	Release cutthroat
Lower Kalama	Year-round	20”	2	Release wild cutthroat
Mid Kalama	Year-round	14”	2	Release wild cutthroat
Upper Kalama	June 1–Mar. 31	14”	2	Release wild cutthroat
EF Lewis	June 1–Mar. 15	—	—	Catch and release
Lower NF Lewis	Year-round	20”	2	Release wild cutthroat
Upper NF Lewis	June 1–Oct. 31	—	—	Catch and release
Cedar Creek	June 1–Mar. 15	12”	2	Release wild cutthroat
Cougar Creek	June 1–Aug. 31	8”	2	--
Salmon Creek	June 1–Mar. 15	12”	2	Release wild cutthroat
Washougal River	June 1–Mar. 15	—	—	Catch and release
Hamilton Creek	June 1–Oct. 31	12”	2	Release wild cutthroat
Wind River	July 1–Mar. 15	14”	2	None
Little White Salmon River	June 1–Oct. 31	8”	2	None

12.9 Cutthroat

12.9.1 Listing Status

To date, no investigation has been published regarding the persistence probability of southwest Washington cutthroat trout populations. The subspecies, sea-run cutthroat trout in the Southwest Washington/Northwest Oregon area, was a candidate for listing as threatened, but the USFWS found that a listing was not warranted.

In April 1999, NMFS and the USFWS issued a joint proposed rule for the listing of southwestern Washington/Columbia River sea-run cutthroat trout. The ESU includes populations of coastal cutthroat trout in the Columbia River and its tributaries downstream from the Klickitat River in Washington and Fifteenmile Creek in Oregon (inclusive) and the Willamette River and its tributaries downstream form Willamette Falls. Cutthroat trout found in the Lewis River are included in this ESU, although the status of Lewis River coastal cutthroat trout is currently unknown because of "*insufficient quantitative information to identify a trend in abundance or survival*" (WDFW 2000).

On April 26, 2000, the coastal cutthroat trout of the Umpqua River ESU (i.e. naturally spawning populations in mainstem and tributaries) was removed from the list of endangered and threatened species because NMFS determined that the Umpqua River population was part of a larger distinct population segment that was not previously, nor currently warrants listing as threatened or endangered under ESA (Federal Register, Vol. 65, No. 81).

On July 5, 2002, the USFWS issued a withdrawal of the Proposed Rule to List the Southwestern Washington/Columbia River Distinct Population Segment of the Coastal Cutthroat Trout as Threatened because of "*the latest information indicating relatively healthy-sized total populations in a large portion of the DPS, and our improved understanding of the ability of freshwater forms to produce anadromous progeny, lead us to conclude that this DPS does not meet the definition of a threatened species (in danger of becoming endangered in the foreseeable future) at this time*." (Federal Register, Vol. 67, No. 129)

12.9.2 Current Viability

Lower Columbia River coastal cutthroat trout are not listed under the Federal ESA. The subspecies was a candidate for listing as "threatened," but the USFWS found on July 2002 that a listing was not warranted (50 CFR 17). Coastal cutthroat trout are widely distributed throughout suitable habitats of lower Columbia River subbasins (Figure 12-9) and historical distribution has not contracted appreciably (USFWS 2002). Cutthroat occur at over 1,300 documented locations within the lower Columbia distinct population segment.

The USFWS also found that, though there were few data to work with, populations in the Washington part of the distinct population segment under review "remained at levels comparable to healthy-sized populations, indicating that large-scale, long-term declines have not occurred at the landscape level." (USFWS 2002). Available density data for tributaries below Bonneville Dam were comparable to those from Olympic Peninsula and Puget Sound populations that were not considered to be in danger of extinction (50 CFR 17). While numbers of sea-run cutthroat appeared to have declined, the USFWS found that resident and anadromous forms were not segregated, and that because resident forms could give rise to anadromous progeny, the presence of healthy subpopulations of resident trout mitigated risks to anadromous forms to some degree.

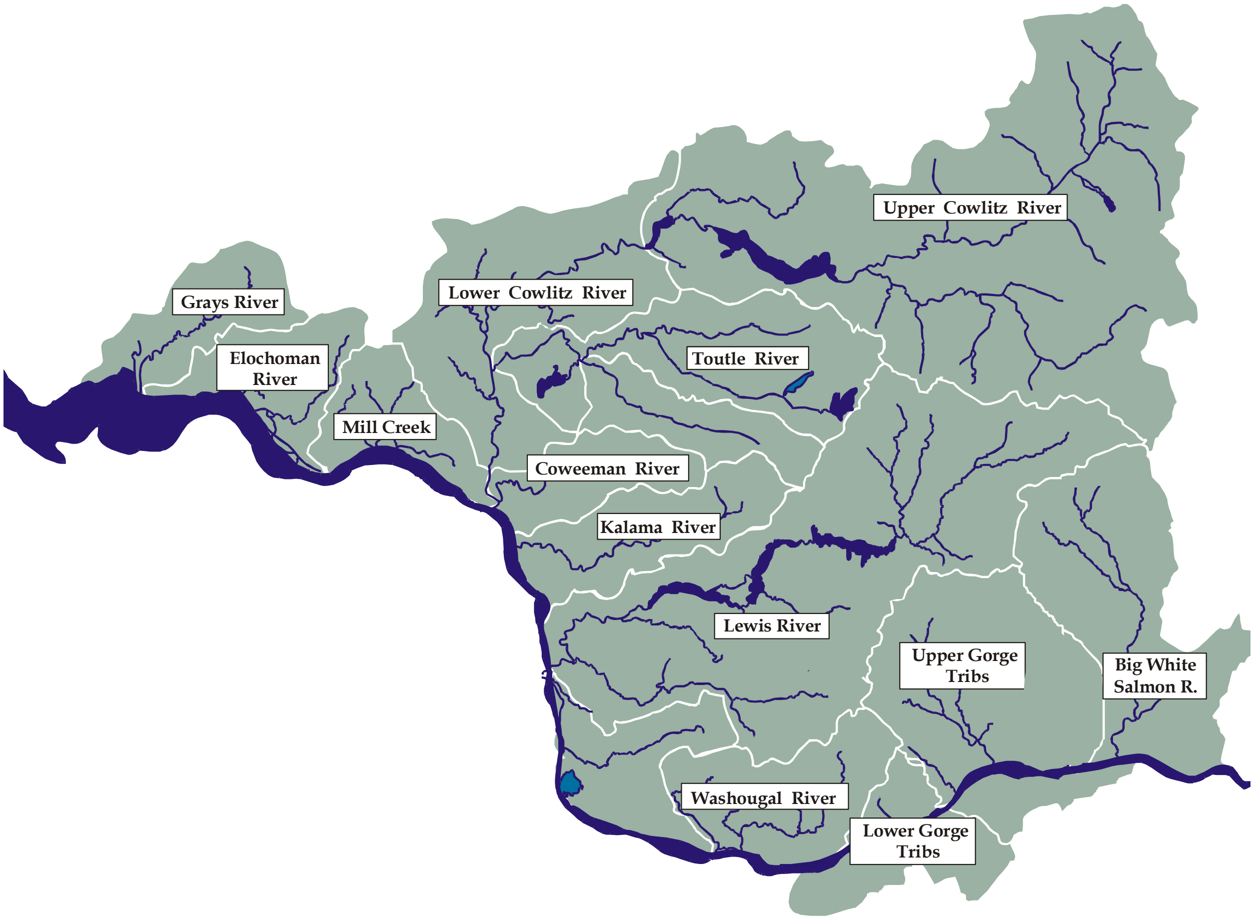

Figure 12-9. Distribution of historical cutthroat trout populations among lower Columbia River subbasins

12.9.3 Summary Assessment

1. Cutthroat trout are widely distributed in Washington lower Columbia River tributary systems and are not federally listed. Numbers of sea-run cutthroat appear to have declined but risks are ameliorated by the presence of healthy subpopulations of resident trout.
2. Current fishing impact is low and additional restrictions are not warranted given the current status of the species.
3. Some hatchery production of sea-run cutthroat occurs. Relative risks and benefits have not been quantified.

Cutthroat are a generalist species that exist in many small streams not suitable for other salmonids. Cutthroat are thus susceptible to habitat changes that do not directly affect anadromous species in Washington lower Columbia tributaries but suitable habitat conditions continue to be widely available.